IN THE SPECIFICATION:

Please amend paragraph number **[0008]** as follows:

[0008] ~~To achieve the foregoing objects, and in~~ In accordance with the purposes of the invention as embodied and broadly described in this document, an instrumented pin member is provided. The instrumented pin member comprises a pin member body disposed about a pin member axis. The pin member body comprises a bending portion. The instrumented pin member further comprises a sensing device positioned at the pin member body within the bending portion for sensing a bending strain in the bending portion exclusive of a net axial strain and for outputting a sensor measurement signal representative of the bending strain. In addition, the instrumented pin member comprises a sensor measurement signal output device for outputting the sensor measurement signal from the sensing device.

Please amend paragraph number **[0009]** as follows:

[0009] ~~Preferably~~ Preferably, but optionally, the sensing device senses components of the bending strain in the bending portion along an x axis and a y axis, wherein the ~~.x axis~~ x axis and the y axis are orthogonal to the pin member axis and to each other.

Please amend paragraph number **[0010]** as follows:

[0010] The pin member body may comprise a bolt, a pin, a screw, an axle, and the like. ~~Preferably~~ Preferably, but optionally, the pin member body has a cylindrical shape about the pin member axis. The pin member head preferably includes a head, and the bending portion is adjacent to the head.

Please amend paragraph number **[0016]** as follows:

[0016] The instrumented pin member ~~preferably but optionally~~ preferably, but optionally, also comprises a switching device operatively coupled to the sensing device for switching between an axial stress measurement configuration and a bending stress measurement configuration. The switching device may comprise a solid state switching circuit. The switching device may be ~~and preferably~~ and, preferably, is positioned at the pin member head. In a presently preferred embodiment, the pin member head includes an external surface and a notch disposed in the external surface, and the switching device is mounted to the external surface. The pin member head also may comprises a head including a head cavity, and the switching device may be positioned at the pin member head cavity.

Please amend paragraph number **[0018]** as follows:

[0018] Where the sensing device comprises a pair of bridges, each having an axial stress measurement configuration and a bending stress measurement configuration, the switching device preferably comprises a switch operatively coupled to the pair of bridges, for switching the pair of bridges between the axial stress measurement configuration and the bending stress measurement configuration. ~~Preferably~~ Preferably, but optionally, the switching device switches the pair of bridges to the bending stress measurement configuration substantially simultaneously.

Please amend paragraph number **[0020]** as follows:

[0020] ~~Preferably~~ Preferably, but optionally, the system comprises a switching device operatively coupled to the sensing device for switching the sensing device in and out of a bending stress mode. The system ~~preferably but optionally~~ preferably, but optionally, comprises a plurality of the instrumented pin members.

Please amend paragraph number **[0044]** as follows:

[0044] ~~Optionally~~ Optionally, but preferably, one or more instrumented pin members, e.g., as described more fully herein, can be substituted at joint 36 for selected ones of noninstrumented pin members 46 so that when motor 30 is fired, the instrumentation, again, for example, as described herein, can measure bending stresses within these instrumented pin members, i.e., at joint 36. A plurality of these instrumented pin members may be disposed, for example, by uniformly distributing them around joint 36, or in other predetermined arrangements. The bending stress data, and in some instances other data as well, from the instrumented pin member or pin members can be used to simulate, estimate or otherwise predict the same stresses that are occurring in the normal operational, noninstrumented pin members and at the joint itself.

Please amend paragraph number **[0046]** as follows:

[0046] System 50 also comprises a control box 55, a preamplifier ("preamp") or data conditioner 56, a storage device 58, e.g., a hard drive on a computer, a processor 60, e.g., such as the processor of a commercially-available personal computer or small business computer, and a display monitor 62. A data recording device 64 such as a strip chart recorder or other device useful for recording data from the instrumented pin members may be used as well. In presently preferred embodiments, the system comprises a computer, preferably having a 12 bit range or above, and a control box 55. Control box 55 is positioned between the pin members 52 and preamp 56 ~~and preferably~~ and, preferably, is located as close to the pin members as is practicable under the circumstances with respect to the electrical connections. Control box 55 is electrically coupled to the sensors, as described below, and receives signals, e.g., analog sensor measurement output signals, from them. It includes an oscillator as described further below, ~~an~~ and an opto-isolator for assisting in isolating the digital signals from the analog signals. Control box 55 is capable of operating in three modes, i.e., a pure axial measurement mode, a pure bending mode, and a switching mode in which it alternates between an axial stress measurement mode and a bending stress measurement mode.

Please amend paragraph number **[0051]** as follows:

[0051] The pin member body 70 according to this aspect of the invention also comprises a bending portion. This portion of the pin member body undergoes bending stresses and experiences associated strains under normal operating conditions for the joint and the device of which it forms a part, e.g., the rocket motor. The bending ~~portion~~ portion, as referred to ~~herein~~ herein, need not constitute the entire portion of the pin member that is subject to bending stresses or strains. It does, however, comprise at least a portion of the pin member body that is subject to bending stress which, in many cases, will include the entire member. The "bending portion," as the term is used herein, refers to any area or portion of the pin member 52 that is suitable for measurement of bending moments under the application and circumstances. Preferably, the bending portion is selected to be a region of the pin member that experiences substantial strain relative to other parts of the pin member during normal operating conditions, and which is representative of the strain occurring in the entire portion of the pin member that is subject to such bending forces. The bending portion, in many instances, will comprise the area immediately adjacent to the pin member head.

Please amend paragraph number **[0053]** as follows:

[0053] Pin member 52 includes a radially chamfered groove 92 in bending portion 90. It preferably is positioned on shank 72 below the base portion 84 of head 74. The positioning of the groove preferably is selected so that unwanted contributions from localized effects at and around the base portion 84 of head 74 are avoided, and so that there is no unwanted interference with the head during installation, maintenance, etc. This groove 92 may be disposed in the shank portion, for example, by lathing pin member 52. The depth of groove 92 radially with respect to perimeter 78 of shank 72 and the length along the longitudinal pin member axis 54 (z axis) may be selected to house and accommodate sensors and associated circuitry, as will be described herein below. In the presently preferred ~~embodiments~~ embodiments, and using the sensors as described herein below, the depth of groove 92 is approximately equal to the depth of the minor thread diameter of the shank threads. Preferably, it is no smaller than the thread root, e.g., to avoid adverse effects on the strength of the pin member. Groove 92 is shown in highly exaggerated depth in Fig. 7 to better illustrate.

Please amend paragraph number **[0054]** as follows:

[0054] ~~Further~~ Further, in accordance with this aspect of the invention, the instrumented pin member includes a sensing device positioned at the pin member body within the bending portion for sensing a bending strain in the bending portion exclusive of a net axial strain and for outputting a sensor measurement signal representative of the bending strain. The sensing device senses the bending strain in the bending portion exclusive of a net axial strain in the sense that it is capable of sensing bending ~~strains, and thus~~ strains and, thus, bending moments, in the bending portion of the pin member, without the measurement being adversely affected by a net axial strain, i.e., without adverse interference or effects of a net tension or compression of the pin member. This may be done, and in the presently preferred embodiments is done, using, among other things, a sensing device wherein such net axial strain components are canceled out.

Please amend paragraph number **[0056]** as follows:

[0056] The sensing ~~device~~ device, according to this aspect of the ~~invention~~ invention, preferably comprises first and second x axis sensor elements for measuring the bending strain along the x axis and first and second y axis sensor elements for measuring the bending strain along the y axis. The sensor elements preferably lie in a plane orthogonal with respect to the pin member longitudinal axis, for example, such as plane 80. In presently preferred embodiments, each of the first and second x and y axis sensor elements comprises an axial sensor for sensing strain in a pin member axial direction corresponding to the pin member axis and a tangential sensor for sensing strain in a direction tangential to the shank perimeter. The tangential direction in these embodiments involves a tangent to shank perimeter, or more accurately to the slightly smaller perimeter of groove 92 in planes orthogonal to longitudinal pin member axis 54 where the sensors reside, for example, as identified in Fig. 7 by reference number 94. Tangential direction 94 thus represents tangent vectors to shank perimeter 78, or to the perimeter of groove 92, and thus constitutes a circumferential tangent to the shank or groove circumference. Given that radial depth of groove 92 in many applications will be quite small relative to the shank diameter, the perimeter for groove 92 and the shank perimeter at a given radial location will be essentially the same.

Please amend paragraph number **[0057]** as follows:

[0057] The sensing ~~device~~ device, according to the preferred ~~embodiments~~ embodiments, will now be described. In these illustrative embodiments, a sensing device is provided which comprises first and second x axis sensor elements BX1 and BX2, respectively, and first and second y axis sensor elements BY1 and BY2, respectively (shown in Fig. 7). Each of the sensor elements lies on the perimeter of groove 92, and thus essentially at shank perimeter 78, all within plane 80. Sensor elements BX1 and BX2 lie along the x axis on opposite sides of shank perimeter 78, and sensor elements BY1 and BY2 lie on the y axis on opposite sides of shank perimeter 78. The x axis sensor ~~elements thus~~ elements, thus, are disposed at 90 degrees with respect to the y axis sensor elements. Each of the sensor elements BX1, BX2, BY1 and BY2 comprises a pair of sensors including an axial or "tension" sensor, denoted by a "T," and a tangential or "compression" sensor, denoted by a "C" after the sensor element designation, e.g., BX1(T) or BX1(C).

Please amend paragraph number **[0061]** as follows:

[0061] The sensing ~~device~~ device, according to presently preferred embodiments of the ~~invention~~ invention, comprises a bridge assembly for receiving the sensor measurement signals and making necessary or appropriate conversions to measure bending stress. In these embodiments, the bridge assembly can assume an axial stress measurement configuration and a bending stress measurement configuration. The bridge assembly may comprise a single ~~bridge, but~~ bridge but, preferably and ~~optionally~~ optionally, comprises a pair of bridges, which still further preferably comprises an x axis bridge and a y axis bridge. A single bridge can be useful in detecting bending strains but typically will not include directional information, or will measure only components of strain along a single plane. In accordance with the presently preferred embodiments, the sensing device comprises a pair of bridges, specifically an x axis bridge 150 and a y axis bridge 250, for example, as shown in Figs. 8 and 9. In these embodiments, each of the bridges 150 and 250 comprises a full active Wheatstone strain gage bridge.

Please amend paragraph number **[0062]** as follows:

[0062] The x axis ~~bridge~~ bridge, in preferred ~~embodiments~~ embodiments, comprises a left side and a right side. The left x axis bridge side comprises first and second positions and the right x axis bridge side comprises first and second positions. The first position of the left x axis bridge side and the first position of the right x axis bridge side comprise what may be termed a "first aligned x axis configuration," and the second position of the left x axis bridge side and the second position of the right x axis bridge side comprise what may be termed a "second aligned x axis configuration." Similarly, the y axis ~~bridge~~ bridge, in preferred ~~embodiments~~ embodiments, comprises a left side and a right side. The left y axis bridge side comprises first and second positions and the right y axis bridge side comprises first and second positions. The first position of the left y axis bridge side and the first position of the right y axis bridge side comprise what may be termed a "first aligned y axis configuration," and the second position of the left y axis bridge side and the second position of the right y axis bridge side comprise what may be termed a "second aligned configuration." The first aligned x axis configuration corresponds to the first aligned y axis configuration, and the second aligned x axis configuration corresponds to the second aligned y axis configuration, as will be illustrated further herein below.

Please amend paragraph number **[0068]** as follows:

[0068] The ~~system~~ system, comprising instrumented pin members 52 with sensors as described and with bridges as shown in ~~Fig. 8~~ Fig. 8, cancels net axial strains and, therefore, measures bending moments. In presently preferred embodiments, however, it is desired and preferred that each instrumented pin member 52 also be configured to operate in an axial stress measurement mode, in which net axial stress is ~~measure~~ measured exclusive of bending moments, and a bending stress measurement mode, in which bending stress is measured exclusive of net axial ~~stresses,, and preferably~~ stresses and, preferably, exclusive of torsional stresses as well.

Please amend paragraph number **[0069]** as follows:

[0069] To implement this feature, the sensing device preferably comprises an axial stress measurement configuration, a bending stress measurement configuration, and a switching device operatively coupled to the sensing device for switching between them. The pin member 52, when placed in the axial stress measurement configuration and ~~operated~~ operated, as described herein, is in the axial measurement mode. When pin member 52 is placed in the bending stress measurement configuration and operated, it is in the bending stress measurement mode.

Please amend paragraph number **[0070]** as follows:

[0070] The sensing device, according to the presently preferred embodiments as disclosed herein, is in the bending stress measurement mode when the axial sensors of the first and second x axis sensor elements are in one of the first aligned x axis configuration and the second aligned x axis configuration, and the axial sensors of the first and second y axis sensor elements are in one of the first aligned y axis configuration and the second aligned y axis configuration. Similarly, the sensing device is in the bending stress measurement configuration when the tangential sensors of the first and second x axis sensor elements are in one of the first aligned x axis configuration and the second aligned x axis configuration, and the tangential sensors of the first and second y axis sensor elements are in one of the first aligned y axis configuration and the second aligned y axis configuration.

Please amend paragraph number **[0074]** as follows:

[0074] A switching ~~device 280~~ device 280, according to the presently preferred embodiments for this aspect of the ~~invention~~ invention, comprises a pair of identical switching circuits 282, one of which is shown in Fig. 10. Switching circuit 282 comprises a pair of 4-ohm complementary metal oxide semiconductor (CMOS) SPDT switches 300 and 400, each of which comprises a pair of field effect transistors (FET). In these preferred embodiments, switches 300 and 400 comprise an Advanced Micro Devices Model ADG719BRM switch, commercially available from Advanced Micro Devices of Sunnyvale, California. Switches 300 and 400 function to reverse the polarity of the right side of bridges 150 and 250, thereby effectively reversing the positions of the sensors at the first and second positions of the right sides of the respective bridges 150 and 250, i.e., between the bridge assembly configurations shown in Figs. 8 and 9. Switch 300 provides the switched coupling of the bridge line providing voltage +XF, and switch 400 provides the switched coupling of the bridge line providing voltage -XF, as shown in Figs. 8 and 9. The switches selected for switching circuits 282 preferably have a very low impedance when in the "ON" state and have an extremely high impedance when in the "OFF" state.

Please amend paragraph number **[0078]** as follows:

[0078] A switching signal source 288 is coupled to the line 284 providing signal BSIG for generating the switching signal thereby provided. Preferably, the switching signal comprises a periodic signal that causes the switching circuitry to switch states periodically. It should be noted, however, that this is not necessarily limiting, and that other switch timing relationships are possible. Switching signal source 288 in the preferred embodiments comprises an oscillator that provides a conditioned, periodic square wave for selectively and periodically triggering switches 300 and 400. Switching signal source ~~288~~ 288, according to the presently preferred ~~embodiment~~ embodiment, is physically located in control box 55 (Fig. 2). Switching signal source 288 also may include circuitry for shaping the ~~signal~~ signal, as is appropriate for the particular switches used. A frequency divider, for example, may be used to better insure that the switching transistor is precise, e.g., by building up the leading or trailing edge of the square wave. In the presently preferred embodiments, switching circuits 282, under the control of the switching signal BSIG, cause each pin member to switch states between the axial stress measurement configuration and the bending stress configuration at a desired rate, depending upon the application. This switching rate may vary from 0 Hz (steady axial or bending mode) to 40 to 50 KHz and possibly higher. Preferred ranges include 10 Hz to 2 ~~KHz, and~~ KHz and, more ~~preferably~~ preferably, about 110 to 500 Hz. Higher frequencies such as 30 to 40 KHz may be useful, for example, when investigating mechanical shock or shock wave phenomena. Natural physical limits on the switching frequency may occur, depending on the circumstance, as will be understood by persons of ordinary skill in the art. Physical limits may be placed, for example, by the impedance of lines coupled to the switches, or by the frequency of the phenomena to be measured.

Please amend paragraph number **[0088]** as follows:

[0088] The cavity 1089 itself may be made in known fashion, i.e., by machining. With reference to Fig. 15, an angled notch 1116 is provided in head 1074, extending from notch 1112 as previously described and extending to the cavity 1089 of broach 1088. Notch 1116 is sized so that ~~leads 1100~~ leads 1110 can pass through it and into cavity 1089. A notch 1115 extends from aperture 1114 into extended portion 1089 of broach 1088. This notch can be useful in gaining access to the cavity 1089, e.g., for placing switching device components, inspecting them, etc.

Please amend paragraph number **[0092]** as follows:

[0092] The system further includes a data receiving device operatively coupled to the sensor signal output device for receiving the sensor output signal. ~~Preferably~~ Preferably, but optionally, the data receiving device comprises a data processor. It also may comprise a data display, a data recorder, a strip chart recorder, or any other device or collection of devices suitable for receiving, storing, processing and/or displaying or presenting the data embodied in the sensor signal. As implemented in the presently preferred embodiments, the data receiving device comprises the components illustrated in Fig. 2, and as described above.